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Oral health of the elderly with Alzheimer's disease

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Objective. The objective of this study was to describe the oral health of elderly people diagnosed with Alzheimer's disease (AD).
Study Design. Thirty elderly subjects with AD (mild, moderate, and severe) and 30 without AD (controls) were included in the study. Volunteer-reported oral health data were collected using the General Oral Health Assessment Index (GOHAI). Demographic and oral characteristics were assessed, including the number of natural teeth; number of decayed, missing, and filled teeth (DMTF); oral health index (OHI); removable prosthesis conditions; and oral pathologies.
Results. GOHAI values were similar for both groups. Compared with the controls, the subjects with AD had a higher age, DMTF, OHI, and number of oral pathologies and a lower educational level and number of natural teeth.
Conclusions. Elderly subjects with AD had poorer oral health than those without the disease. Despite the positive self-perception of their oral health, the oral health of subjects with AD tended to decline as their disease progressed. (Oral Surg Oral Med Oral Pathol Oral Radiol 2012;114:338-343)

Alzheimer's disease (AD) is the most common manifestation of elderly dementia. This neurodegenerative disease is characterized by extracellular β-amyloid peptide (neuritic plaques), hyperphosphorylated tau protein (neurofibrillary tangles), and neuronal or synaptic loss.[1,2] The neural dysfunction preferentially affects cholinergic synaptic transmission, which is responsible for attention and learning processes.[3] The multifactorial etiology of AD involves genetic and environmental risk factors,[4] such as family history, apolipoprotein E, Down's syndrome, advanced age, lower educational level, history of head injury, cardiovascular disease, and female gender.[1]

AD progressively shows increased severity, resulting in impairment of cognitive skills.[2] In the mild to moderate stages of AD, the cognitive decline includes memory loss, language problems, gradual disorientation in time and space, difficulties in performing normal daily activities, and inabilities to learn new things.[2,4] People with AD who have difficulties in motor skills and in the ability to perform oral and personal care[2] have an increased risk for developing medical complications and stomatological disorders. In the severe stage, cognitive abilities are severely impaired, progressing to complete loss of recent and remote memory.[2] As a result, people with severe AD become dependents and require caregivers.[4]

The prevalence of AD increases with the age. The prevalence is approximately 3% for subjects aged 65 to 74 years, 19% for those between 75 and 84, and 47% for subjects older than 85.[3] AD occurs more often in women, who account for two-thirds of AD cases.[5]

Treatment of patients with AD seeks to improve functional[4] and cognitive performance,[3] delay loss of daily living activities, stabilize mood,[3] reduce behavioral disturbances,[6] and improve the quality of life.[4] Increasing the quality of life and general health among the elderly is related to maintaining natural teeth and having well-fitted prostheses.[7] Considering that cognitive and motor abilities are compromised in subjects with AD, this circumstance can lead to inadequate biofilm control and oral hygiene.[8] For example, subjects with AD forget to remove prostheses, resulting in the accumulation of food debris and dental biofilm on the remaining teeth.[3] In addition, the elderly become dependent on their caregivers, who may not have the skills or knowledge necessary to provide dental care.[8]

Patients with dementia experience more oral diseases than healthy people.[9] The number of teeth with coronal and cervical caries increases with increasing AD severity.[10] Compared with individuals without dementia,

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patients with AD have significantly more gingival plaque, bleeding, and calculus,[10] and have older and less clean dentures.[11] Although previous studies have provided useful insights about oral health status in elderly individuals with AD, researchers have not yet evaluated subjective assessments or self-reported oral health data in this population.

Self-reported oral health is important, as it can be used to provide patients with AD and caregivers with accurate approaches for dental care. Therefore, this study aimed to describe the oral health of elderly diagnosed with AD, objectively using oral assessments and subjectively using the General Oral Health Assessment Index (GOHAI).

MATERIAL AND METHODS

This cross-sectional study included a group of 60 elderly subjects who were participants in the Program of Cognitive and Functional Kinesiotherapy in Elderly with Alzheimer's Disease (PRO-CDA) and in the Program of Physical Activity for Elderly (PROFIT) at Paulista State University "Julio de Mesquita Filho" (Rio Claro, São Paulo, Brazil). The group with AD was composed of older subjects, who were participants in PRO-CDA (n = 30). They were in the mild (n = 11), moderate (n = 12), and severe (n = 7) stages of AD and had a mean age of 79.13 ± 5.59 years (23 women and 7 men). All subjects in the group with AD were diagnosed with AD by a neuropsychiatrist using the *International Classification of Diseases* (ICD-10),[12] *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV),[13] Mini-Mental State Examination (MMSE),[14] and Clinical Dementia Rating (CDR).[15] The control group was composed of participants in PROFIT (n = 30). The control subjects had a mean age of 67.80 ± 5.45 (23 women and 7 men), and all subjects were without AD or other forms of dementia. The present study followed the Helsinki Declaration and the consent forms were approved by the Ethics Committee of Piracicaba Dental School, State University of Campinas, and signed by caregivers in the group with AD and by the volunteers themselves in the control group.

The volunteers were asked about their sociodemographic characteristics, including age, educational level, and monthly income. Additionally, they were asked about their dental and medical histories, which were registered during the anamnesis.

Subjective assessment

Patient-based assessment of oral health problems was evaluated using the GOHAI[16,17] with its validated Portuguese version.[18] Volunteers with AD completed the assessment in the presence of their caregivers, and the control volunteers completed the assessment themselves. A single examiner asked the participants about 12 GOHAI items in reference to the previous 3 months, and they were asked to respond using a 3-point scoring scale (always, sometimes, or never).[18,19] Volunteers from the group with AD, mainly those in the severe stage of AD (who accounted for 23.3% of the group with AD), were assisted by their caregivers in answering the GOHAI items when necessary. The final GOHAI score was calculated as previously described by Atchison and Dolan.[16] The GOHAI score could range from 12 to 36.[18,19] Scores of 34 to 36 were classified as high, scores of 31 to 33 were moderate, and scores less than 30 were low.[20] Subjects presenting high GOHAI scores indicated that they had a positive perception of their oral health, and those with lower GOHAI scores had more self-reported oral health problems and were expected to have poorer oral health conditions.[16,17]

Objective assessment

Clinical examinations were performed to objectively assess oral health in all of the subjects. The clinical examination used a probe, mouth mirror, and flashlight to evaluate each subject's teeth, removable prosthesis, and presence of oral pathologies, such as ulceration and prosthetic stomatitis.[21] The number of teeth present in the mouth was registered, and the teeth were categorized as decayed if they were cavitated; missing if they were extracted or extraction was indicated; and filled if they presented amalgam, resin, or prosthetic crowns. The sum of the decayed, missing, and filled teeth (DMTF) was the DMFT index.[21]

The level and position of biofilm and calculus on buccal and lingual exposed teeth surfaces were scored as described by Greene and Vermillion.[22] The biofilm index was determined by summing the scores recorded for biofilm and then dividing the total by the number of teeth scored. The calculus index was determined by summing the calculus scores recorded and then dividing the total by the number of teeth scored. Then, both the biofilm and calculus indexes were summed to give the Oral Hygiene Index (OHI).[22]

Complete denture (CD) and removable partial denture (RPD) prostheses were evaluated inside and outside the mouth. The evaluation recorded stability, retention, occlusion, vertical height, and defects.[23] The length of time using the maxillary and mandibular prostheses was also recorded.

The presence of biofilm on the prosthesis was also evaluated. All CDs and RPDs were first rinsed in running water for 5 seconds to remove food debris. Then, the biofilm-disclosing agent, 1% neutral red, was applied with a swab. The disclosing agent was applied at 8 regions of the superior and/or inferior CDs. Four regions were located on the buccal surface, and 4 were

Table I. Sociodemographic and oral characteristics of the control subjects and subjects with AD

	Control (n = 30)	*AD (n = 30)*	*P value*
Age, median (min.-max.)	66.0 (59.0-81.0) B	78.0 (68.0-89.0) A	<.0001
Educational level, y, median (min.-max.)	7.25 (2.0-16.0) A	4.0 (0.0-14.0) B	.0098
Monthly income (real minimum wage), median (min.-max.)	3.0 (1.0-9.0) A	2.25 (1.0-9.0) A	.2769
Edentulous, frequency (%)	10 (33.3) A	15 (50.0) A	.1904
Dentates, frequency (%)	2 (6.7) A	0 (0.0) A	.4915
Partially dentates, frequency (%)	18 (60.0) A	15 (50.0) A	.4363
CD in both jaws, frequency (%)	10 (33.3) A	15 (50.0) A	.1904
CD and RPD, frequency (%)	2 (6.7) A	7 (23.3) A	.1455
Only RPD, frequency (%)	7 (23.3) A	2 (6.7) A	.1455
Only maxillary CD, frequency (%)	2 (6.7) A	4 (13.3) A	.6707
Fixed prosthesis, frequency (%)	3 (10.0) A	1 (3.3) A	.6120
No removable prosthesis, frequency (%)	4 (13.3) A	1 (3.3) A	.2027

Distinct letters indicate statistical differences ($P < .05$).
AD, Alzheimer's disease; CD, complete denture; max., maximum; min., minimum; RDP, removable partial denture.

Table II. Subjective and objective variables in the control subjects and subjects with AD

	Control group	*Group with AD*	*P value*
GOHAI	32.0 (17.0-36.0) A	33.0 (22.0-36.0) A	.1024
Number of teeth	13.5 (0.0-28.0) A	1.0 (0.0-22.0) B	.0004
DMTF	25.5 (12.0-28.0) B	28.0 (22.0-28.0) A	.0024
OHI	2.2 (0.3-8.0) B	4.5 (1.7-10.0) A	.0023
Biofilm on the prosthesis	2.5 (1.0-4.0) A	2.9 (0.06-4.0) A	.1668
Time using maxillary prosthesis, years	2.0 (0.6-22.0) A	8.0 (0.1-64.0) A	.0530
Time using mandibular prosthesis, years	2.0 (0.6-22.0) A	6.0 (0.1-40.0) A	.1009

Data are represented as the median (minimum–maximum). Distinct letters indicate statistical differences ($P < .05$).
AD, Alzheimer's disease; DMTF, decayed, missing, and filled teeth; GOHAI, General Oral Health Assessment Index; OHI, oral health index.

on the basal tissue contact surface.[24] The CD biofilm index was obtained by averaging the 8 scores.[25] Given the Kennedy classification and several modification areas of the RPDs, the biofilm-disclosing agent was applied on the buccal and basal tissue contact surfaces of the RPD's major edentulous area. The RPD biofilm score was calculated as the average of the scores measured for the major edentulous area. The prosthesis biofilm present in both the CD and RPD was then scored as described by Augsburger and Elahi.[24] The final biofilm index was obtained by averaging the biofilm scores of the maxillary and mandibular prosthesis.

Statistical analysis

The statistical analysis was performed using the SAS statistical program (release 9.2, SAS Institute, Inc., Cary, NC). Descriptive analyses for the oral characteristics of the sample, removable prosthesis conditions, and the presence of oral pathologies were performed using the χ^2 or Fisher's exact tests. After exploratory analysis of the data in terms of age, educational level, monthly income, GOHAI, number of teeth, DMTF, OHI, presence of biofilm on prosthesis, and time of prosthesis use, we found that these data did not meet the parametric analysis assumptions. Thus, the Mann-Whitney test was used to compare the groups, and the Kruskal-Wallis and Dunn post hoc tests were used to compare the control subjects with subjects of different AD stages. All statistical tests were carried out using a 5% significance level.

RESULTS

The summary of sample characteristics is shown in Table I. A homogeneous distribution was observed between groups, except the group with AD presented a higher age ($P < .0001$) and lower educational level ($P = .0098$).

Comparisons between the groups showed that the GOHAI scores were similar and considered moderate[20] for both groups ($P = .1024$) (Table II). This result demonstrated that the subjects had a positive self-perception of their oral health; however, subjects with AD presented a fewer number of natural teeth ($P = .0004$), and higher DMTF ($P = .00024$) and OHI ($P = .0023$) values than the controls. Comparisons between the GOHAI scores of subjects with AD of different disease stages and the controls revealed that the GOHAI scores were similar. The GOHAI scores were considered high only for subjects with AD in the severe stage of the disease ($P = .4135$) (Table III). The number of natural teeth was lower for subjects with AD in the moderate and severe stages of the disease ($P = .0223$). A similar trend was observed for the DTMF values, which were

Table III. Subjective and objective variables in the control subjects and subjects with AD subdivided by disease stage

		AD			
	Control group	*Mild*	*Moderate*	*Severe*	*P value*
GOHAI	32.0 (17.0-36.0) A	33.0 (22.0-36.0) A	32.5 (25.0-36.0) A	34.0 (25.0-34.0) A	.4135
Number of teeth	13.5 (0.0-28.0) A	4.0 (0.0-22.0) AB	0.0 (0.0-10.0) B	0.0 (0.0-14.0) B	.0223
DMTF	25.5 (12.0-28.0) B	27.0 (22.0-28.0) AB	28.0 (23.0-28.0) A	28.0 (24.0-28.0) A	.0191
OHI	2.2 (0.3-8.0) B	4.0 (1.9-10.0)AB	5.0 (1.7-5.3) AB	7.5 (5.0-10.0) A	.0042
Biofilm on the prosthesis	2.5 (1.0-4.0) A	2.9 (2.2-4.0) A	2.4 (0.06-4.0) A	3.2 (1.7-3.9) A	.0857
Time of use of maxillary prosthesis, years	2.0 (0.6-22.0) A	12.5 (0.5-40.0) A	5.0 (0.1-64.0) A	6.5 (1.0-40.0) A	.2001
Time of use of mandibular prosthesis, years	2.0 (0.6-22.0) A	12.5 (5.0-30.0) A	4.0 (0.1-40.0) A	6.5 (1.0-40.0) A	.2631

Data are represented as the median (minimum–maximum). Distinct letters indicate statistical differences ($P < .05$).
AD, Alzheimer's disease; DMTF, decayed, missing, and filled teeth; GOHAI, General Oral Health Assessment Index; OHI, oral health index.

Table IV. Frequency (%) of removable prosthesis conditions and presence of oral pathology in control subjects and subjects with AD

	Control group	*Group with AD*	*P value*
Stability of maxillary prosthesis			
Unsatisfactory	1 (11.1)	8 (88.9)	.0691
Satisfactory	17 (46.0)	20 (54.0)	
Stability of mandibular prosthesis			
Unsatisfactory	9 (34.6)	17 (65.4)	.1978
Satisfactory	8 (57.1)	6 (42.9)	
Retention of maxillary prosthesis			
Unsatisfactory	3 (37.5)	5 (62.5)	1.000
Satisfactory	15 (39.5)	23 (60.5)	
Retention of mandibular prosthesis			
Unsatisfactory	12 (52.2)	11 (47.8)	.1500
Satisfactory	5 (29.4)	12 (70.6)	
Occlusion			
Unsatisfactory	3 (42.9)	4 (57.1)	1.000
Satisfactory	7 (38.9)	11 (61.1)	
Vertical height			
Acceptable	7 (41.2)	10 (58.8)	1.000
Too low	3 (37.5)	5 (62.5)	
Defects of maxillary prosthesis			
Absent	13 (36.1)	23 (63.9)	.4260
Present	5 (50.0)	5 (50.0)	
Defects of mandibular prosthesis			
Absent	13 (39.4)	20 (60.6)	.4316
Present	4 (57.1)	3 (42.9)	
Oral pathology			
No	25 (62.5)	15 (37.5)	.0062
Yes	5 (25.0)	15 (75.0)	

AD, Alzheimer's disease.

higher in subjects with moderate and severe AD ($P = .0191$). The OHI data showed higher values only for subjects with severe AD versus the controls ($P = .0042$) (Table III).

Analysis of removable prosthetic conditions between subjects with AD and healthy volunteers revealed a significant association ($P = .0062$) between the presence of oral pathology and AD (Table IV). Prosthetic stomatitis was the most commonly observed lesion, with a prevalence of 60%.

DISCUSSION

Volunteer-reported oral health is not well established in the literature for the elderly with various types of dementia, and AD specifically. The present study evaluated the oral health of subjects with AD in the mild, moderate, and severe stages of the disease with the GOHAI. To obtain reliable answers related to their oral problems and reduce the possibility of error, all subjects with AD were assessed in the presence of their caregivers.

The subjects with AD were older and had a lower educational level than the controls. These findings are in agreement with the literature, as higher age and lower educational level has been shown to increase the risk of AD.[1,26] The prevalence of AD is doubled after the age of 60,[26] and a higher education level is associated with a delay in the onset of AD.[26] Considering the oral characteristics observed in this study, edentulous subjects with and without AD were using CD in both jaws, which contrasts with some studies[27,21] that reported a higher percentage of patients with AD without CDs. The present study evaluated individuals who were living in their own homes, and the previous studies evaluated subjects with AD living in nursing homes. Nursing home patients may present more compromised oral health than individuals who live in their own homes,[21] which could explain this difference in findings.

Regarding the subjective assessments, no differences were observed between the group with AD and the control group in the GOHAI values, which were considered moderate[20] (Table II). Although there are few reports on subjective assessments of subjects with AD, the results of the present study differ from those found by Warren et al.,[28] which demonstrated that among patients presenting other types of dementia, subjects with AD reported better self-perceived oral health than controls. Warren et al.[28] used a subjective questionnaire different from the GOHAI, which may explain the difference in results. In addition, the self-perception of

oral health in the elderly may also be influenced by the belief that some pain and disability are inevitable in old age, which might lead subjects to overestimate their oral health status[18,29] and account for the positive perception of oral health in the present study.

The GOHAI values for subjects with and without AD showed that the subjects had a positive self-perception, indicating that the elderly participants judged their oral health status using criteria different from dentists.[18] In comparing the number of natural teeth, DMTF, and OHI values, the subjects with AD presented worse values than the controls. Because dementia results in cognitive and voluntary motor skill impairments, it compromises adequate oral hygiene,[8] which may explain these results. Moreover, comparisons among controls and subjects of different AD stages showed that the GOHAI values were similar among these groups. This result demonstrated that the subjects had an inaccurate perception of their oral conditions; however, objective variables, such as the number of teeth, DMTF, and OHI, demonstrated worsening oral health condition with AD progression, which is consistent with the results of previous studies.[10,21,30] A higher OHI value was observed for subjects in the severe AD stage. This result may be related to the impairment caused by AD progression and the increased burden on the caregiver,[28] who might not have the skills or knowledge[8] to provide adequate oral health care.

The qualitative assessments indicated that prosthetic stomatitis was the most common oral pathology presented by subjects in this study. Seventy-five percent of subjects who presented oral pathologies also had AD. This result may be related to a decrease of submandibular salivary flow in nonmedicated patients with AD,[31] which is considered an effect of the disease itself,[32] or it may be associated with the pharmacologic therapy, which includes anticholinergic side effects that cause hyposalivation.[2,30] Hyposalivation reduces oral lubrication and antibacterial, antiviral, and antifungal activities,[3] which might predispose subjects with AD to oral diseases.

The control group data in the present study was in agreement with the data from the literature, including the results reported by Warren et al.[28] and Adam and Preston.[21] Compared with our results, these studies reported a similar number of remaining teeth in the mouth and OHI values in healthy subjects, respectively. On the other hand, the DMTF for the controls in the present study was lower than that measured by Silva et al.,[20] which is probably because of the smaller sample size in this study.

Studies using GOHAI[18,19] usually require a larger sample size. Because the present study evaluated a small number of subjects, this could be considered a limitation of this research. However, it is important to emphasize that this study had a cross-sectional design, and the results of this study could provide important data about the oral health of patients with AD.

CONCLUSIONS

The results of the present study demonstrate that oral health was poorer in elderly subjects with AD than in those without the disease. Although volunteers in both the AD and control groups reported a positive self-perception of their oral health, the subjects with AD showed declining oral health conditions with disease progression.

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